AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (currently amended) A method of manufacturing a joint by operating a riveting system having a riveting tool, a self-piercing rivet, and automotive vehicle panels, the riveting tool including an electric motor and a rivet punch, the method comprising:

(a) determining if the self-piercing rivet is located in the riveting tool;

(b) moving the self-piercing rivet to the riveting tool if step (a) is negative;

(c) energizing the electric motor to advance the self-piercing rivet;

(d) rotating a portion of the electric motor in response to step (c);

(e) converting the rotation of step (d) to linear displacement of the rivet punch with a non-fluid transmission;

(f) the rivet punch pushing against a solid head of the self-piercing rivet during insertion into the automotive vehicle panels;

(g) advancing the self-piercing rivet into an unpierced portion of the automotive vehicle panels, in response to step (e)~~, without fluid actuation in the riveting tool~~;

(h) outwardly diverging a leading end of the self-piercing rivet during insertion of the self-piercing rivet into the automotive vehicle panels;

(i) preventing the self-piercing rivet from completely piercing through a die side one of the automotive vehicle panels; ~~and~~

(j) automatically determining displacement associated with the rivet punch ~~as a function of actuation speed used~~ to insert the self-piercing rivet;

(k) deenergizing the electric motor and transmitting an error signal if an unacceptable condition is determined;

(l) clamping the automotive vehicle panels together in an area substantially surrounding the riveting area; and

(m) automatically comparing and displaying actual sensed values to previously stored reference values.

2. (currently amended) The method of claim 1 further comprising sensing a length of the self-piercing rivet ~~deenergizing the electric motor and transmitting an error signal if an unacceptable condition is determined~~.

3. (currently amended) The method of claim 7 ~~1~~ further comprising pneumatically feeding the self-piercing rivet to a position adjacent the punch and sensing a length of the rivet ~~clamping the automotive vehicle panels together in an area substantially surrounding the riveting area~~.

4. (currently amended) The method of claim 1 wherein ~~further comprising the rivet punch pushing against a solid head of the self-piercing rivet during insertion into~~ the automotive vehicle panels are aluminum.

5. (previously presented) The method of claim 1 further comprising comparing real-time sensed displacement associated with the rivet punch to prestored displacement values.

6. (original) The method of claim 1 further comprising automatically moving a C-frame by a robotic arm, the riveting tool being attached to the C-frame.

7. (currently amended) A method of manufacturing a joint by operating a riveting system having a riveting tool, a C-frame, a die, a self-piercing rivet, and automotive vehicle members ~~panels~~, the riveting tool including an electric motor and a rivet punch, the method comprising:

(a) robotically moving the C-frame to align a joint area of the automotive vehicle members ~~panels~~ between the rivet punch and the die;

(b) inserting a self-piercing rivet to the riveting tool;

(c) rotating a portion of the electric motor;

(d) linearly moving the rivet punch in a fluid-free manner;

(e) clamping the automotive vehicle members ~~panels~~ together in an area substantially surrounding the joint area;

(f) punching the self-piercing rivet into a solid portion of the automotive vehicle members ~~panels~~;

(g) using the die to outwardly diverge a leading end of the self-piercing rivet during insertion of the self-piercing rivet into the automotive vehicle members ~~panels, always keeping the rivet punch and die coaxially aligned during use of the riveting tool~~;

(h) preventing the self-piercing rivet from completely piercing through a die side one of the automotive vehicle members ~~panels~~; ~~and~~

(i) sensing a real-time riveting characteristic ~~velocity of a component coupled to at least one of: the electric motor and the rivet punch~~; and

(j) stopping advancing motion of the punch when a head of the self-piercing rivet is substantially flush with a punch-side surface of one of the automotive vehicle members.

8. (original) The method of claim 7 further comprising deenergizing the electric motor and transmitting an error signal if an unacceptable condition is determined.

9. (currently amended) The method of claim 7 wherein ~~further comprising clamping~~ the automotive members are aluminum~~vehicle panels together in an area substantially surrounding the joint area~~.

10. (currently amended) The method of claim 7 further comprising the rivet punch pushing against a solid head of the self-piercing rivet during insertion into the automotive vehicle members ~~panels~~.

11. (original) The method of claim 7 further comprising comparing real-time sensed displacement associated with the rivet punch to prestored displacement values.

12. (currently amended) The method of claim 13 ~~7~~ further comprising sensing a length of the self-piercing rivet ~~always keeping the rivet punch and die coaxially aligned during use of the riveting tool~~.

13. (currently amended) A method of manufacturing by operating a riveting system including an electric motor, ~~a belt, a~~ transmission means for converting rotary motion to linear motion in a non-fluidic manner, a punch, a die, a workpiece clamp, a C-frame, and a self-piercing rivet, the method comprising:

(a) ~~stationarily~~ attaching the die to the C-frame;

(b) pneumatically feeding the self-piercing rivet to a position adjacent to the punch;

(c) sensing if the self-piercing rivet has been fed adjacent to the punch;

(d)~~(c)~~ rotating a portion of the electric motor;

~~(d) rotating the belt in response to rotation of the electric motor;~~

(e) rotating a portion of the non-fluidic transmission means ~~in response to rotation of the belt~~;

(f) linearly displacing the punch in response to rotation of the portion of the non-fluidic transmission means;

(g) linearly advancing the workpiece clamp;

(h) using the punch to directly contact against and linearly push a solid head of the self-piercing rivet;

(i) using the die to outwardly diverge a leading end of the self-piercing rivet while preventing the self-piercing rivet from contacting directly against the die~~, always keeping the rivet punch and die coaxially aligned during use of the riveting tool~~;

(j) sending a signal between a computer controller and a sensor, and the sensor sensing a characteristic associated with the electric motor; and

(k) electronically comparing a sensed and real-time action associated with operation of at least one of: the electric motor, the non-fluidic transmission means, and the punch, to at least one pre-programmed value.

14. (original) The method of claim 13 further comprising deenergizing the electric motor and transmitting an error signal if an unacceptable condition is determined.

15. (original) The method of claim 13 further comprising clamping a pair of aluminum, automotive vehicle panels together in an area substantially surrounding the riveting area.

16. (original) The method of claim 13 further comprising inserting the self-piercing rivet into an unpierced area of automotive vehicle panels to be joined.

17. (original) The method of claim 13 further comprising automatically sensing and automatically comparing real-time values associated with the punch to prestored values, the values being a function of at least one of: displacement and speed.

18. (original) The method of claim 13 further comprising robotically moving the C-frame to align a joint area of automotive vehicle panels to be joined between the punch and the die, a rotational axis of the electric motor being offset from an elongated axis of the punch.

19. (currently amended) The method of claim 13 further comprising sending a signal between a computer controller and a sensor, and the sensor sensing a characteristic associated with at least one of: the punch and the non-fluidic transmission means.

20. (original) The method of claim 13 further comprising sending a signal between a computer controller and a sensor, and the sensor sensing a characteristic associated with the electric motor.

21. (currently amended) A method of riveting automotive vehicle workpieces with a riveter, a frame, a die, and a self-piercing rivet, the method comprising:

(a) robotically moving the frame to align a joint area of the automotive vehicle panels between a rivet driver of the riveter and the die~~, the rivet punch and die always being coaxially aligned during use of the riveter~~;

(b) automatically determining if a length of the self-piercing rivet in a feeding system is acceptable;

(c) supplying the self-piercing rivet to the riveter;

(d)~~(c)~~ rotating a portion of an electric motor of the riveter;

(e)~~(d)~~ linearly moving the rivet driver in a direct-mechanically connected ~~fluid-free~~ manner in response to step (d) ~~(c)~~;

(f)~~(e)~~ clamping the automotive vehicle workpieces together adjacent a solid portion of the automotive vehicle workpieces to be riveted;

(g)~~(f)~~ pushing the self-piercing rivet into the solid portion of the automotive vehicle workpieces;

(h)~~(g)~~ outwardly diverging a leading end of the self-piercing rivet, with the die, during insertion of the self-piercing rivet into the automotive vehicle workpieces;

(i)~~(h)~~ preventing the self-piercing rivet from completely piercing through a die side one of the automotive vehicle workpieces; and

(j)~~(i)~~ sensing a real time value of the electric motor during riveting operation and automatically comparing the real time value to a desired, stored value.

22. (New) The method of claim 21, further comprising pneumatically feeding the self-piercing rivet to the riveter.

23. (New) The method of claim 21 wherein the frame is a substantially C-shaped frame with the die mounted on one arm of the frame and the riveter mounted on the other arm of the frame.

24. (New) The method of claim 21, further comprising moving a spindle and nut, engaged with each other, of the riveter to direct mechanically advance the rivet driver.

25. (New) The method of claim 21, further comprising automatically calculating a force displacement curve based on the riveting and displaying the curve.

26. (New) The method of claim 21, further comprising pushing the rivet driver against a solid head of the self-piercing rivet.

27. (New) A method of riveting workpieces employing a self-piercing rivet, a joint, a C-frame, a die, a punch and an electric motor, the method comprising:

(a) inserting the workpieces into the C-frame between the die and the punch;

(b) energizing the electric motor and causing rotary motion of the motor to linearly advance the punch which drives the self-piercing rivet;

(c) using a sensed signal input to indicate a dimension of the self-piercing rivet; and

(d) automatically deenergizing the electric motor and preventing the self-piercing rivet from completely piercing through a die-side one of the workpieces.

28. (New) The method of claim 27, further comprising:

(a) determining if a portion of the self-piercing rivet is substantially flush with an exterior surface of one of the workpieces; and

(b) controlling energization of the electric motor in order to stop advancement of the punch when the desired flushness of the self-piercing rivet portion relative to the one workpiece is determined.

29. (New) The method of claim 27, further comprising controlling the electric motor to rotate a threaded spindle which linearly drives the punch in a mechanical and fluid-free manner.

30. (New) The method of claim 27, further comprising causing a robot to move a fastening tool, including the electric motor and punch, relative to the workpiece.

31. (New) The method of claim 27, further comprising determining an actual electrical power characteristic of the electric motor and comparing the actual electrical power characteristic to a desired electrical power characteristic.

32. (New) The method of claim 27, further comprising automatically storing calculated riveting characteristic values and displaying historical trends between riveting process cycles.

33. (New) A method of riveting comprising:

(a) energizing an automatic actuator to advance a rivet driving member;

(b) automatically feeding a first sized rivet to a position aligned with the member;

(c) automatically feeding at least a second sized rivet to the position aligned with the member, the first and second sized rivets having different dimensions;

(d) automatically selecting which of the sized rivets to be fed to the position.

34. (New) The method of claim 33, further comprising joining workpieces with the rivets, wherein the rivets diverge within and do not fully pierce completely through the workpieces joined by the rivets, when acceptable joints are created.

35. (New) The method of claim 33, further comprising pneumatically feeding the rivets from storage locations to the position aligned with the member, and energizing a transmission means to advance the member, the member including a rivet punch.